SSC
Solid State Contactors

Two-phase control of three-phase loads

User manual

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USER MANUAL

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CE EUROPEAN DIRECTIVES

CE MARKING AND SAFETY

SSC products carry the CE mark in compliance with the essential requirements of the European Low Voltage Directive 73/23/EEC of 19/2/73 (amended by the Directive 93/68/EEC of 22/7/93).
For safety reasons, these products installed and used in compliance with this User Manual meet the essential requirements of the European Low Voltage Directive mentioned above.

ELECTROMAGNETIC COMPATIBILITY (EMC)

For an industrial environment only, must not be used in domestic environments.

The manufacturer certifies that these products, installed and used in compliance with these Instructions, meet the following EMC standards and enable the system which incorporates them to comply with the EMC Directive, as far as the these products are concerned.

EMC test standards

Immunity	Generic standard	:	EN 50082-2
	Test standards	:	EN 61000-4-2, EN 61000-4-4, EN 61000-4-3, EN 61000-4-6,ENV 50204
Emission	Generic standard	:	EN 50081-2
	Test standard	:	EN 55011 Class A
	Product standard	:	IEC 1800-3 second environment (industrial environment)

Internal EMC filters

EMC filters are incorporated in the SSC to reduce conducted emission in accordance with the corresponding test standard.

EMC Guide

In order to help reduce the effects of electromagnetic interference depending on the product installation, Eurotherm can supply the 'Electromagnetic Compatibility' Installation Guide (ref: HA 025464).
This guide lists the rules generally applicable for EMC.

DECLARATION OF CE CONFORMITY

A declaration of CE conformity is available on request.

Validation by Competent Body

The manufacturer has validated the compliance of SSC products with the European Low Voltage Directive and with EMC standards through product design and laboratory testing.

The tests carried out on SSC products are listed in a Technical Construction File validated by the LCIE (Central Laboratory for the Electrical Industries), a Recognized Competent Body.

Further information

For any further information, or if in doubt, please contact the manufacturer where qualified staff are available to advise or assist you with the commissioning of your installation.

PRECAUTIONS

Safety symbols

Important safety precautions and special information are indicated in the text of the manual by two symbols:

DANGER

This symbol means that failure to take note of the information given in this manual may have serious consequences for the safety of personnel and may even result in electrocution.

WARNING

This symbol means that failure to take note of the information may

- have serious consequences for the installation or
- lead to the incorrect operation of the power unit.

These symbols must be observed for particular points.
However the whole of the manual remains applicable.

Personnel

The installation, configuration, commissioning and maintenance of the power unit should only be carried out by personnel qualified and trained to work with low voltage electrical equipment in an industrial environment.

Independent alarm

Given the value of the equipment controlled by SSC products it is the responsibility of the user, and it is highly recommended, that an independent safety device (alarm) should be installed. This alarm must be tested regularly.

The manufacturer can supply suitable equipment

Chapter 1

IDENTIFYING THE SOLID STATE RELAYS

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Chapter 1 IDENTIFYING THE SOLID STATE RELAYS

GENERAL INTRODUCTION

This series of solid state relays (SSCs) are SSC units designed to control the electrical power in industrial three-phase loads.

The SSC is made up of two channels, each comprising a pair of SSCs connected in reverse-parallel, and a direct (unswitched) channel.

It is designed to control three-phase resistive loads:
- elements with a low temperature coefficient
- short-wave infrared elements (except for the 63A model).

Three-phase loads can be connected:
- in star without neutral
- in closed delta

The power wiring is independent of the supply phase rotation.

The nominal line-to-line voltage ranges from 200Vac to 500Vac depending on the product code of the unit.
The nominal currents, defined at an ambient temperature of 45°C, are between 16A and 63A per phase, depending on the rating of the unit.

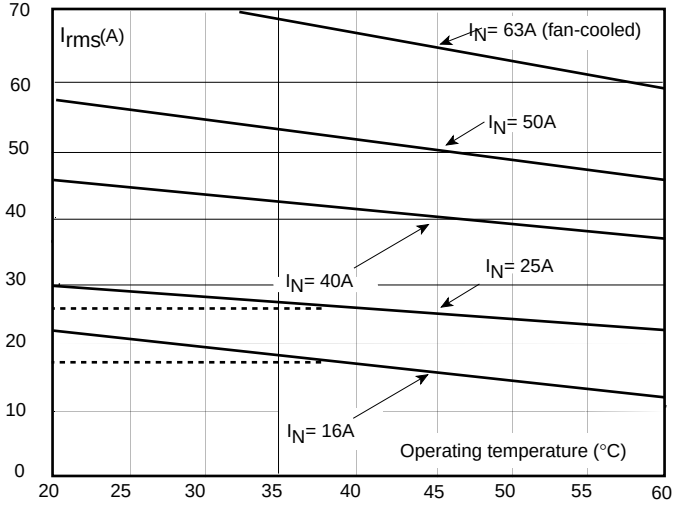

Figure 1-1 Current derating per phase as a function of ambient temperature (dotted line: current limited by recommended fuse)

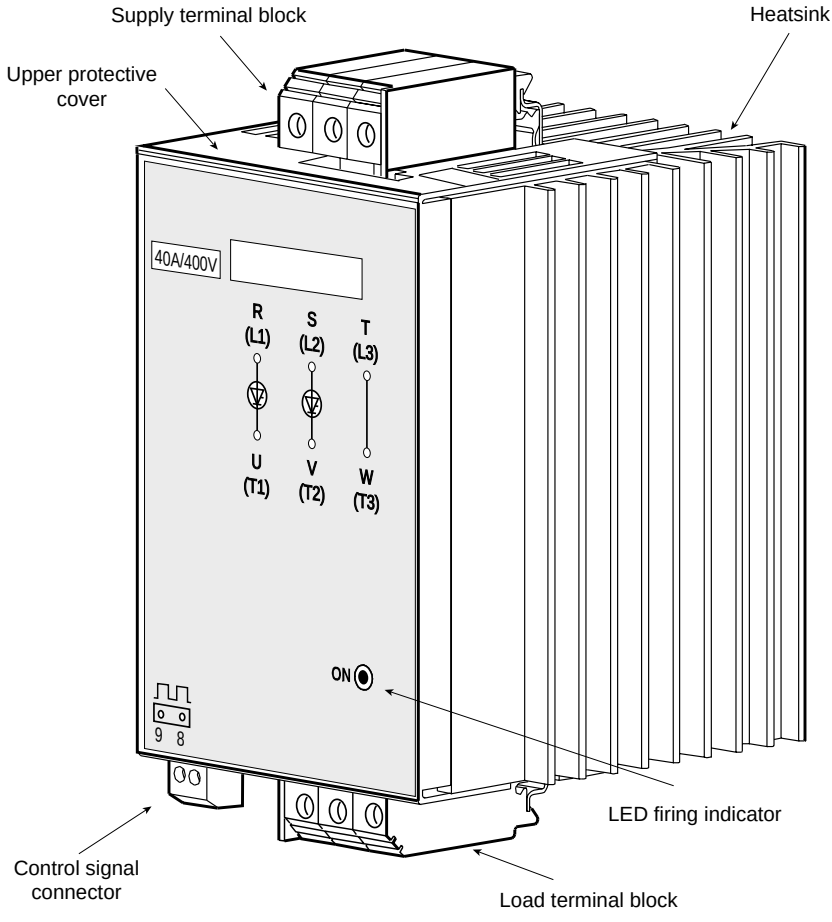

Figure 1-2 Overview (non fan-cooled unit)

The firing mode for SSCs is Logic ON/OFF.

The SSC can be controlled by DC or AC logic signals (configured at the factory depending on the order code).

The electronics of SSCs are self-supplied from the power voltage and do not require external connections.

An SSC is equipped with:

- A ‘driver board’
- A ‘firing board’ which triggers SSC firing.

The filter which provides immunity against electromagnetic interference is located between the power phases.

The user terminal block below the SSC is used for input signal connection without needing access to the inside of the unit.

A green LED, labelled ‘ON’, indicates SSC firing and is located on the front facia.

These SSCs are designed to be bulkhead or DIN rail mounted.

The 63A rated unit must be permanently fan-cooled.
The fan power supply is 115Vac or 230Vac (to be specified when ordering the SSC).

In the event of the SSC overheating, a thermal switch stops SSC firing in the 63A rated version .
Firing becomes possible again after return to nominal thermal conditions.

TECHNICAL SPECIFICATION

These SSCs are intended for two-phase control of an industrial three-phase load.

Power

Nominal current (per phase)	16A, 25A, 40A, 50A or 63A (at 45°C)
Line-to-line voltage	200Vac to 500Vac (±10%) depending on the voltage code
Supply frequency	50Hz and 60Hz (±2Hz) automatic selection
Dissipated power	1.3W (approx.) per amp, per phase
Insulation (1 min test)	Between power and ground: In series 2000Vac, 50Hz Between power and control: In series and 3600Vac, 50Hz.
Cooling	Natural convection for 16A to 50A rated units Permanent fan-cooling for 63A rated unit
Fan power supply	115Vac or 230Vac (selected in order code)
Load	Resistive three-phase load with a low temperature coefficient Short-wave infrared elements (except for 63A rated unit)
Supply phases	Wiring independent of the phase rotation
Load configuration	3-wire: Closed delta or star without neutral
Fuses	External (order separately) see chapter 5

CE Marking

Electrical safety	These SSCs carry the CE mark in compliance with the essential requirements of the European Low Voltage Directive 73/23/EEC (amended by the Directive 93/68/EEC)

Electromagnetic compatibility

Immunity and Emissions	These products comply with Electromagnetic Compatibility test standards (see page iv).

SSC firing

Firing mode	Logic ON/OFF
Switching	Firing starts and ends at zero voltage
Indication	SSC firing is signalled by a green LED

Control

Signal type	DC Logic or AC Logic The signal type (DC or AC) is configured at the factory according to the order code; it cannot be re-configured by the user
DC signal	Universal input: voltage or current. Polarity insensitive: '+' and '-' can be crossed
'On' state	Guaranteed conditions for firing: voltage greater than 5Vdc or current greater than 5mA Maximum voltage: 32Vdc. Maximum current (self-limited) 10mA at 32Vdc
'Off' state	Voltage less than 2Vdc or current less than 0.5mA
AC signal 24 to 48 Vac	Typical input impedance 2.2kΩ (50Hz & 60Hz)
'On' state	Guaranteed conditions for firing: voltage from 20Vac to 53Vac
'Off' state	Voltage less than 5Vac
AC signal 100 to 230 Vac	Typical input impedance 9.6kΩ (50Hz); 8.0kΩ (60Hz)
'On' state	Guaranteed conditions for firing: voltage from 85Vac to 253Vac
'Off' state	Voltage less than 10Vac

Environment

Operating temperature	0°C to +60°C at maximum altitude of 2000m (see page 1-2 for derating curves)
Storage temperature	-10°C to +70°C
SSC protection	External high-speed fuses except for short-wave infrared application (see chapter 5) Internal MOVs (varistors) and RC snubbers
Protection	IP20 (in compliance with Standard IEC 529)
External wiring	To be carried out in compliance with Standard IEC 364
Operating atmosphere	Non-explosive, non-corrosive, non-conductive
Humidity	RH: 5% to 95%, non-condensing, non-streaming
Pollution	Pollution degree 2 permissible, defined by IEC 664 Over-voltage category III, defined by IEC 664

PRODUCT CODE

TE200S/Current/Voltage/Cooling/Input signal/Mounting/Manual/AX144

Nominal current	Code
16 amps	16A
25 amps	25A
40 amps	40A
50 amps	50A
63 amps	63A

Line voltage (line-to-line)	Code
200V, 220V, 230V, 240V	240V
380V, 400V, 415V 440V, 480V	400V
500V	500V

Fan supply	Code
Without fan-cooling (16A to 50A)	000
With fan-cooling (63A):	
115Vac	115V
230Vac	230V

Input signal	Code
Logic signal	
• Universal DC	LGC
• AC 24 - 48Vac	LAC
• AC 100 - 230Vac	HAC

Mounting	Code
Bulkhead	BKD
DIN rail	DIN

Manual language	Code
English	ENG

EXAMPLE OF PRODUCT CODE

Solid state relay and installation parameters

Nominal load current	35 amps
Nominal supply voltage	415 volts line-to-line
Input signal	AC 48Vac
Mounting	On DIN rails
User manual	In English

SSR code:

TE200S / 40A / 480V / 000 / LAC / DIN / ENG /AX144

SERIAL NUMBER LABELS

Two identification labels provide all the information relating to the factory settings of the SSC.

The identification labels are located on the sides of the unit.

Barber-Colman 2.20
Rockford, Illinois :
MODEL : TE200S/40A/480V/000/LAC/DIN/ENG/AX144

SERIAL No. : INT100/002/001/04/98 0F222935

CURRENT : 40A VOLTAGE : 480V AUX. POWER SUPPLY : SELF-SUPPLIED
INPUT : 24-48Vac FAN POWER SUPPLY : NONE
FUSE : FERRAZ B093910. ANY NON-SPECIFIED FUSE INVALIDATES GUARANTEE

Figure 1-3 Example of identification labels.
The information corresponds to the product code example

Warning!

Following any re-configuration on the part of the user, there is no guarantee that the SSC will correspond to the label information

Chapter 2

INSTALLATION

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Chapter 2 INSTALLATION

Please read thoroughly before installing the SSC

INSTALLATION - SAFETY

Danger !

SSC units must be installed by personnel qualified and trained to work with low voltage electrical equipment in an industrial environment.

Units must be installed in electrical cabinets correctly fan-cooled to ensure that condensation and pollution are excluded.
The cabinet must be closed and bonded to the safety ground in accordance with Standards NFC 15-100, IEC 364 or current national Standards.

For installations which are fan-cooled, it is recommended that a fan-failure detection device or a thermal safety cut-out should be fitted in the cabinet.

These SSC units may be bulkhead or DIN rail mounted.

The units must be mounted with the heatsink positioned vertically, with no obstructions above or below which could inhibit or impede airflow.

If several units are mounted in the same cabinet, they should be arranged in such a way that air expelled from one cannot be drawn into the unit located above it.

Warning !

The units are designed to be used at an ambient temperature less than or equal to 45°C at full load or up to 60°C at partial load (see Current derating curves, page 1-2).

Leave a minimum gap of 5cm between two units placed side by side.

Excessive overheating of the SSC may lead to incorrect operation of the unit. This may in turn cause damage to the components.

DIMENSIONAL DETAILS

Non fan-cooled solid state contactors

The overall dimensions of non fan-cooled SSCs (16A to 50A ratings) are given in Figure 2-1.
Weight of non fan-cooled SSC: 2.3kg

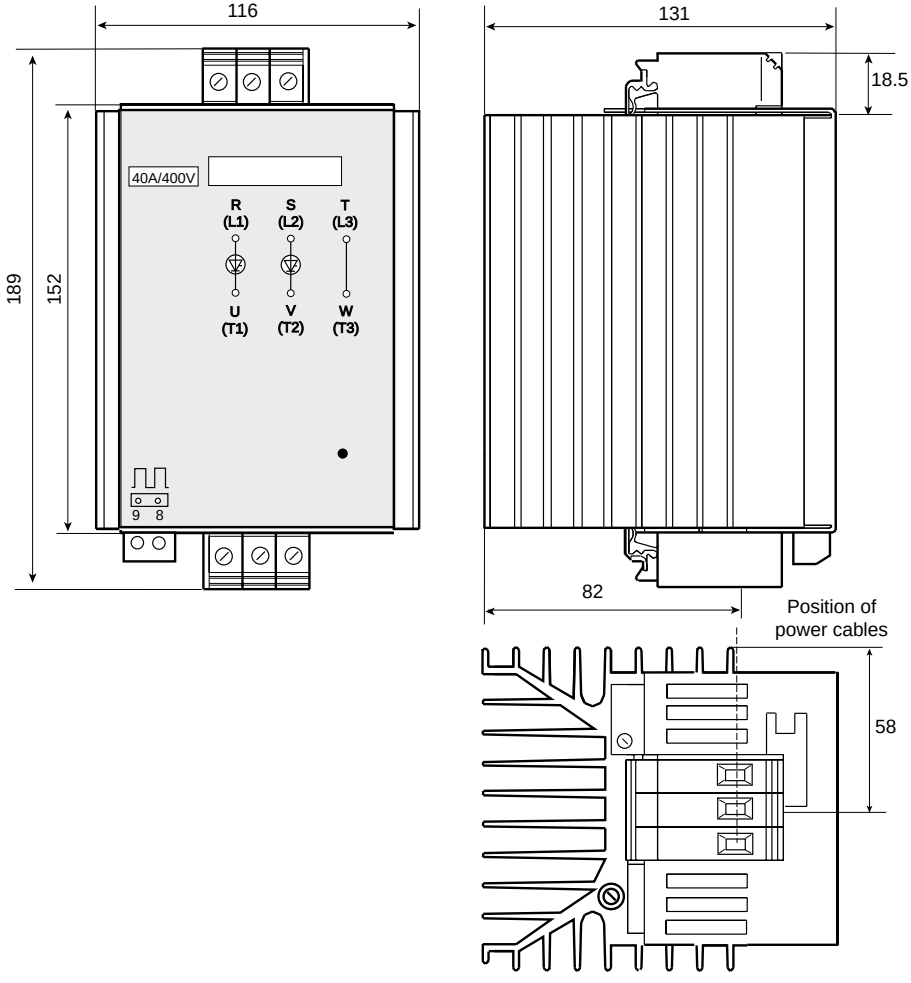

Figure 2-1 Dimensions (mm) of non fan-cooled solid state contactor

Fan-cooled solid state contactor

63A rating SSCs have permanent fan-cooling.
Weight of fan-cooled SSC: 2.9kg
The overall dimensions of the fan-cooled SSC are given in Figure 2-2.

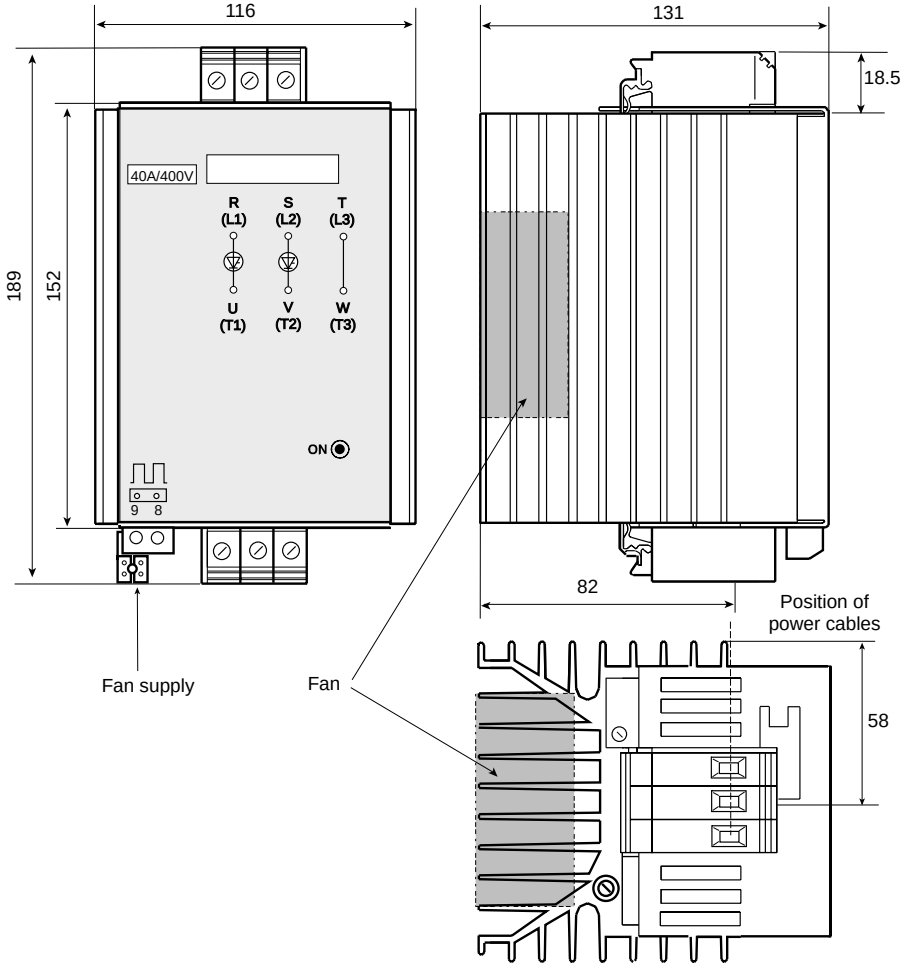

Figure 2-2 Dimensions (mm) of fan-cooled solid state contactor (63A rating)

MOUNTING DETAILS

SSCs may be mounted:

- On two DIN rails (code DIN)
- On a bulkhead (code BKD)

DIN rail mounting

For mounting SSCs, use symmetrical DIN rails to comply with Standard EN 50022.

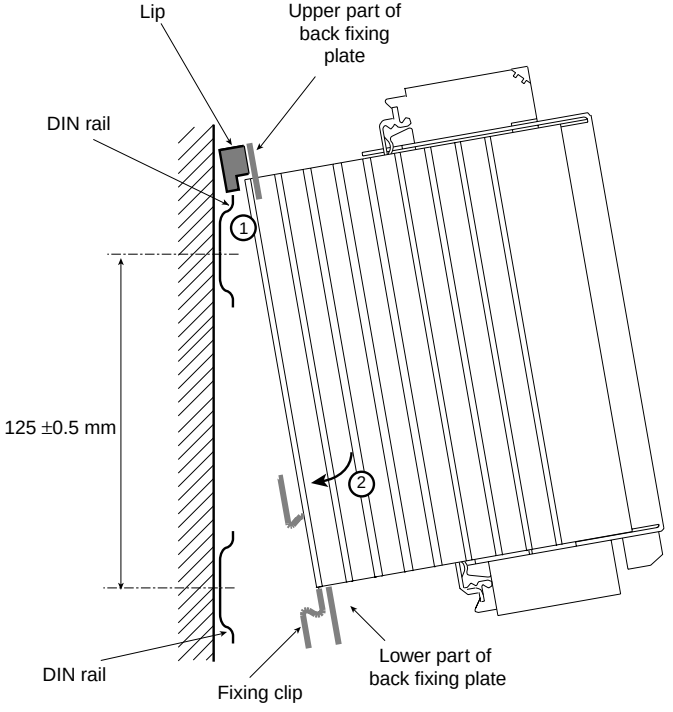

Figure 2-3 DIN rail mounting

To mount the SSC on DIN rails:

1. Offer up the unit by first engaging the two lips on the upper part of the fixing plate (back plate of SSC) on to the upper DIN rail.
2. Clip the SSC (by its spring clip) on to the lower DIN rail, making sure that the clip is properly engaged.

Bulkhead mounting

Two fixing plates, supplied with the SSC (code BKD), are used for bulkhead mounting. For this type of mounting, use the following instructions:

- Drill three holes for M6 screws following the dimensions given in Figure 2-4
- Fix the upper plate on to the panel using the oblong hole at the top of the unit
- Install the lower plate with two M6 screws
- Insert the fixing lugs of the controller into the lower plate
- Slightly undo the central screw holding the upper fixing plate in order to slide it upwards, position the controller on the lower fixing plate and slide the upper plate back down on to the slots on the heatsink.

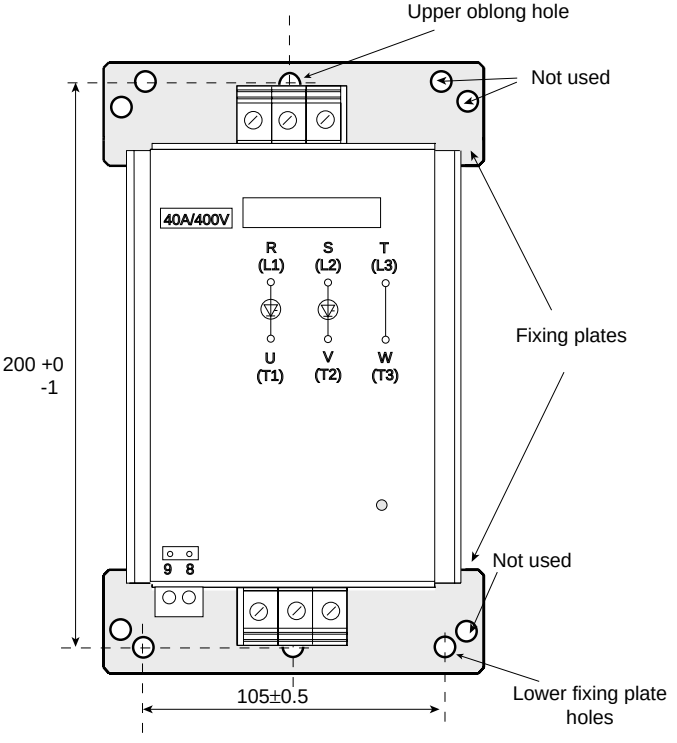

Figure 2-4 Bulkhead drilling and mounting dimensions (in mm).

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WIRING

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Chapter 3 WIRING

WIRING - SAFETY

The SSC units have an IP20 protective cover.

Danger !

Wiring must only be carried out by personnel who are qualified to work in a low voltage industrial environment.

It is the user's responsibility to wire and protect the installation in accordance with current professional Standards. A suitable device ensuring electrical isolation between the equipment and the supply must be installed upstream of the unit in order to permit safe operation.

Danger !

Before any connection or disconnection, ensure that power and control cables or leads are isolated from voltage sources.

For safety reasons, the safety grounding cable must be connected before any other connection is made during wiring and it should be the last cable to be disconnected. The safety ground is connected to the screw located on the upper part of the controller and is denoted by the symbol:

Warning !

To ensure correct grounding (EMC) of the unit, make sure that it is correctly mounted on the reference ground surface (panel or bulkhead). Failing this, it is necessary to add a ground connection at most 10cms long between the ground connection and the reference ground surface.

Danger !

This connection, which is intended to ensure good ground continuity, can never be used to replace the safety ground connection.

CONNECTIONS

Power

The power terminal blocks (line and load) are cage terminal blocks.
The safety ground is connected to an M5 screw.

Control

The control terminal block has a screw connector.
This terminal block plugs in.

Fan (63A rated unit)

The fan connection (for fan-cooled units) is made by means of cage terminal blocks.

Connection details

The terminal capacities and tightening torques to be observed are given in Table 3-1.

Parameter	Power & load supply	Safety ground	Control
Terminal capacity (mm^2)	10 to 25	Equal to or greater than power cross-section	1.5
Tightening torque (Nm)	2	2	0.7

Table 3-1 Connection details

Warning !

The cross-section of the conductors to be used must comply with Standard IEC 943.

POWER WIRING DIAGRAM

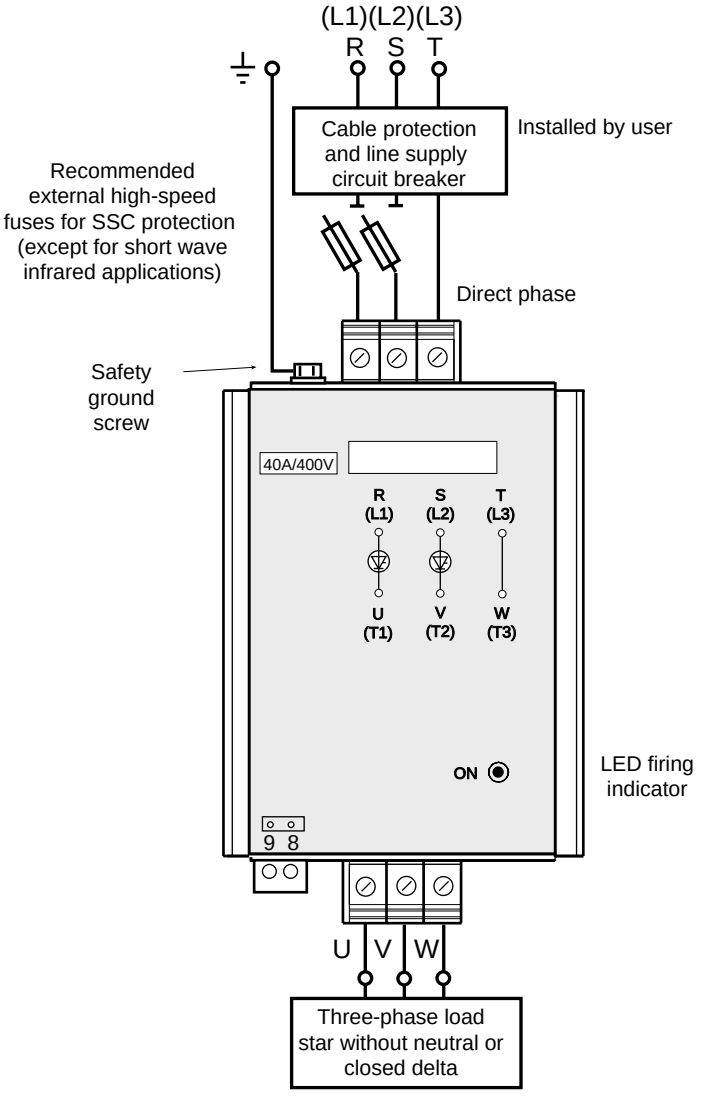

Figure 3-1 Power and safety ground wiring for a load connected in 'star without neutral' or in 'closed delta' (3-wire configuration)

USER TERMINAL BLOCKS

General introduction

The user terminal blocks comprise:

- A control terminal block (located below the SSC, on the left side)
- A fan terminal block for the 63A rated unit (located in front of the control terminal block)

Terminal numbers	Function
7 9	Input for 100 to 230Vac AC control (code HAC, terminal 8 is not used with this code)
8 9	Input for DC control (code LGC)(polarity insensitive) or for 24 to 48Vac AC control (code LAC)
115V or 230V	Fan supply (63A rating)

Table 3-2 Function of user terminals

Terminal functions are given on the label located on the front facia.

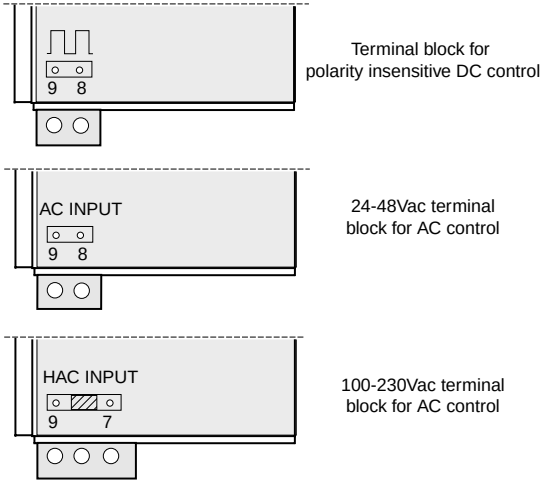

Figure 3-2 Control terminal block labels

Control terminal blocks

There are two types of control terminal block depending on the input type of the SSC:

- 2-way terminal block for DC control and 24 to 48 Vac AC control
- 3-way terminal block for 100 to 230Vac AC control.

LGC and LAC codes

The logic signal for polarity-insensitive DC control (LGC code) or for 24 to 48 Vac AC control (LAC code) must be connected to the 2-way control connector between terminals 8 and 9.

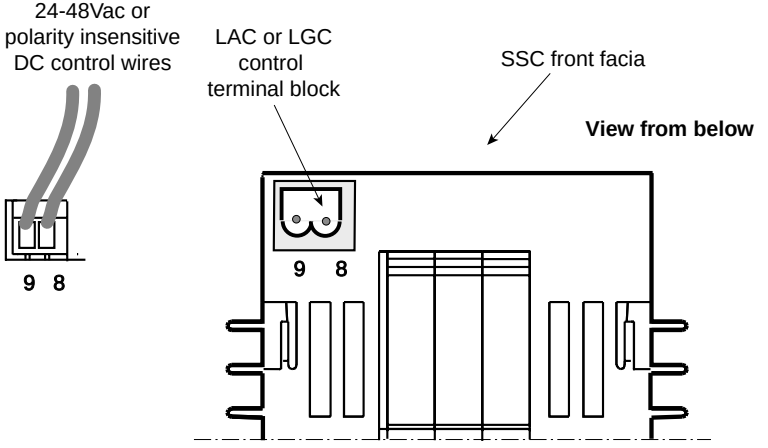

Figure 3-3 Control terminal block for LGC and LAC codes

HAC code

The logic signal for 100 to 230Vac AC control (HAC code) must be connected to the 3-way control connector between terminals 7 and 9.

Terminal 8 is not used.

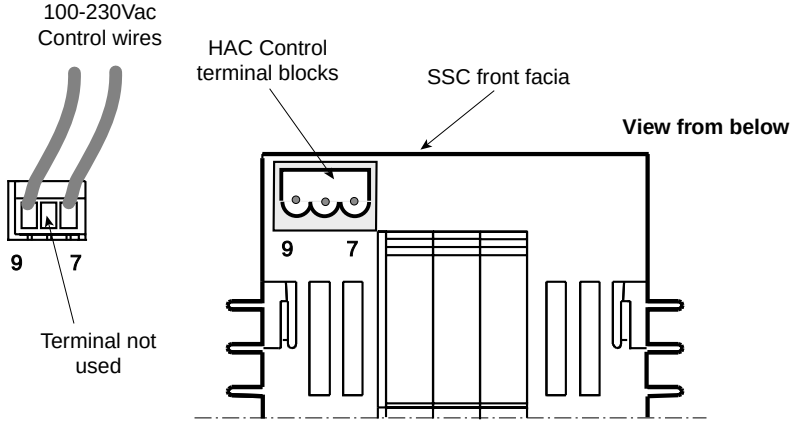

Figure 3-4 Control terminal block for HAC code

WIRING FOR CONTROL AND FAN SUPPLY

Control

The DC logic signal can be provided by 2000 series temperature controllers for example configured for DC logic outputs (see Figure 3-5).

Control by AC voltage is accomplished by contacts (or triac) provided by temperature or other AC logic output controllers.
These contacts (or triac) apply the AC voltage specified in the product code (24 - 48 Vac or 100 - 230 Vac) to the SSC input configured for this voltage.

Warning!

A 0.5A protective fuse must be installed in each feed wire connected to a supply phase.

Contact (or triac) protection

The contacts (or triac) must be protected against overvoltages at the moment of opening by an RC circuit (snubber), often integrated into temperature controllers (see Figure 3-6).

Maximum value of capacitor in the protective RC circuit:
22nF for 100 - 230 Vac (50 Hz and 60Hz ±2Hz);
47nF for 24 - 48 Vac (50 Hz and 60Hz ±2Hz).

Warning!

Increasing this value can lead to permanent conduction of the SSC.

Fan (63A rated unit)

The value of the fan supply voltage (115 Vac or 230 Vac) for fan-cooled units is specified in the SSC product code.

Warning!

The fan connection must have a 0.5A protective fuse installed in each feed wire connected to a supply phase.

Examples of control and fan wiring

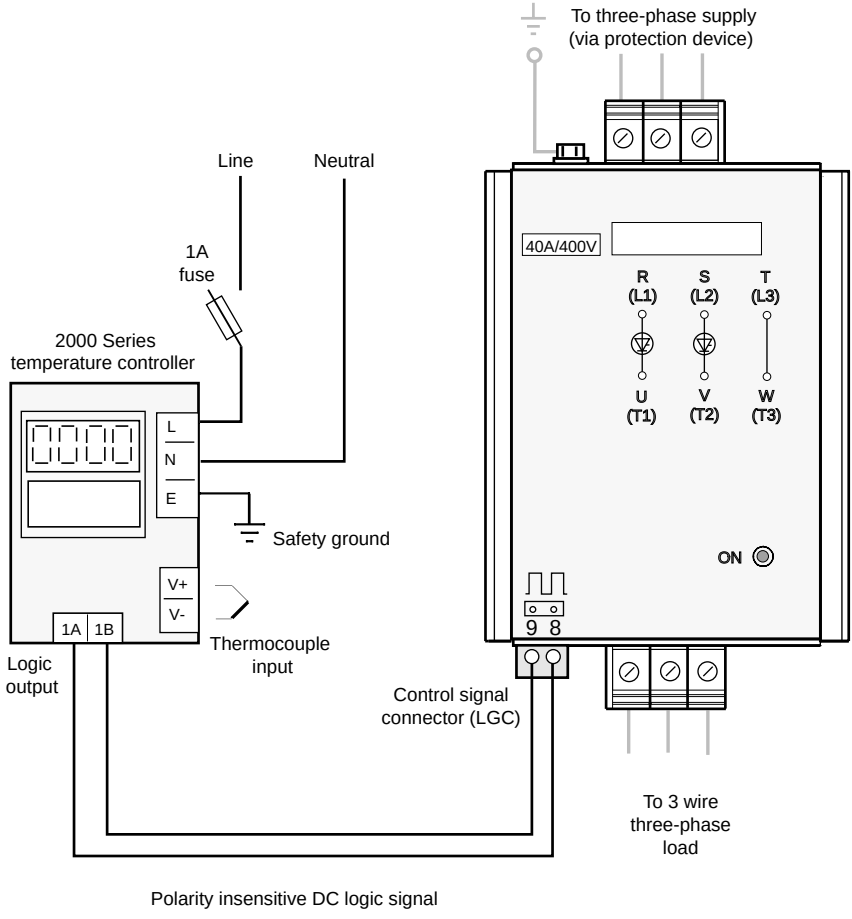

Figure 3-5 Example of DC signal wiring

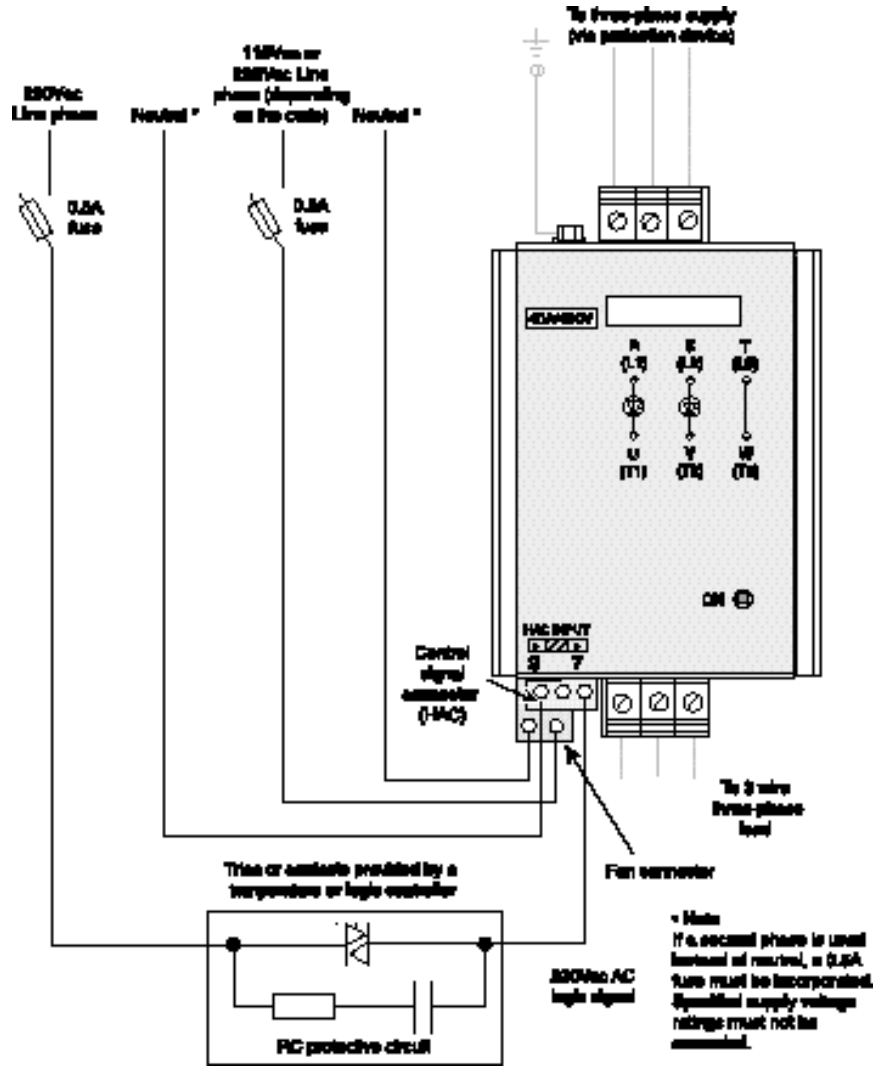

Figure 3-6 Example of wiring for 230 Vac AC signal and fan (63A)

Chapter 4

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Chapter 4 COMMISSIONING PROCEDURE

COMMISSIONING PROCEDURE - SAFETY

Important !

The manufacturer cannot be held responsible for any damage to persons or property or any financial loss or costs arising from incorrect use of the product or failure to observe the instructions contained in this manual.

It is therefore the user's responsibility to ensure, before commissioning the unit, that all the nominal ratings of the unit are compatible with the conditions of use and the installation.

Danger !

A SSC is not an isolating device.
Touching a load terminal even with a zero load current is as dangerous as touching live line supply.

Only personnel qualified and trained to work with low voltage electrical equipment in an industrial environment should have access to the interior of the unit.

Access to internal components of the unit is prohibited to users who are not authorized to work in an industrial low voltage electrical environment.

The temperature of the heatsink may exceed 100°C.
Avoid all contact, even occasional, with the heatsink when the SSC is operational.
The heatsink remains hot for around 15mins after the unit has been switched off.

CHECKING THE CHARACTERISTICS

Load current

The maximum load current must be less than or equal to the value of the nominal current of the SSC, taking into account the load and power supply variations.

For the total power (P) of a three-phase load and for the line-to-line voltage VL, the current is:

$$I = \frac{P}{\sqrt{3} \times VL}$$

In order to take supply voltage and load value tolerances into account, allow a minimum 20% safety margin between the result of the calculation given above and the nominal current of the SSC.

Warning !

The nominal current of the SSC (I_N) must be greater than or equal to 1.2 x I.

If three identical loads are configured in closed delta, the current of each phase of the SSC is √3 times greater than the current in each branch of the load.

Supply voltage

The nominal value of the SSC voltage must be greater than or equal to the line-to-line voltage of the supply used.

Fan supply voltage (63A rated unit)

For 63A rated fan-cooled SSCs, the fan must be provided with a 115Vac or 230Vac supply.

The fan supply voltage is set at the factory, depending on the product code ordered.

Control signals

Configuration of the input type required by the user is also set at the factory, depending on the product code ordered.

Check that the label on the front facia corresponds to the control setup:
Terminals 8 and 9

- No legend - DC logic input
- “AC Input” legend:- 24 to 48Vac input
- “HAC Input” legend:- 100 to 230Vac input

POWERING UP

These SSCs are ready to operate correctly immediately after installation and wiring in accordance with this user manual.

After checking that the nominal parameters of the SSC (voltage, current, input signal) are compatible with those of the installation, apply volts to the SSC.

Check that the current in each phase of the SSC is equal to 0 in the absence of the control signal.

Make sure that the r.m.s. current in each phase does not exceed the nominal rating when the control signal is present.

Chapter 5

MAINTENANCE

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Chapter 5 MAINTENANCE

Danger!

The SSC must be maintained by personnel qualified and trained to work with low voltage electrical equipment in an industrial environment.

The user's installation must be protected upstream (non high-speed fuses, thermal or electromagnetic circuit breaker, suitable fuse-isolator) and must comply with current standards.

FUSES

SSC protection

These SSCs are protected in the following way:

- by external high-speed fuses against overcurrents (except for short-wave infrared applications); these fuses must be ordered separately;
- by RC snubbers and internal MOVs (varistors) which protect against fast voltage transient and transient overvoltages.

Danger !

High-speed fuses are used only for the internal protection of SSCs against large amplitude overloads.
Under no circumstances should these fuses be used to protect the installation.

Warning !

For the use of high-speed fuses in short-wave infrared applications, please contact the manufacturer.

Warning !

For resistive loads (except short-wave infrared applications) the use of any $ fuses other than those recommended for SSC protection will invalidate the guarantee.

To protect the SSCs, depending on the wiring configuration the following combinations may be used:

- Two ‘single-phase fuse and fuseholder’ assemblies installed in the controlled phases or
- One ‘three-phase fuse and fuseholder’ assembly installed between the SSC and the cable protection and line supply circuit breaker; in the direct phase it is possible to install a solid link instead of a fuse.

References for the ‘fuse and fuseholder’ assemblies and for spare fuses are given in the following tables.

Nominal current		**Spare fuse References:**		**Code Fuse+fuseholder Assembly**	**Dimensions (mm)**
TE200S	**Fuse**	**Model Code**	**Ferraz**		
16A	20A	CH 260024	K330013	FU1038/16A/00	81 x 17.5 x 68
25A	30A	CH 260034	M330015	FU1038/25A/00	81 x 17.5 x 68
40A	50A	CH 330054	B093910	FU1451/40A/00	95 x 26 x 86
50A	63A	CS 173087U063	T094823	FU2258/50A/00	140 x 35 x 90
63A	80A	CS 173246U080	W076310	FU2760/63A/00	150 x 38 x 107

Table 5-1 Recommended high-speed fuses for SSC protection
Single-phase fuseholders.

Nominal current		**Spare fuse References:**		**Code Fuse+fuseholder Assembly**	**Dimensions (mm)**
TE200S	**Fuse**	**Model Code**	**Ferraz**		
16A	20A	CH 260024	K330013	FU3038/16A/00	81 x 52.5 x 68
25A	30A	CH 260034	M330015	FU3038/25A/00	81 x 52.5 x 68
40A	50A	CH 330054	B093910	FU3451/40A/00	95 x 79 x 86
50A	63A	CS 173087U063	T094823	FU3258/50A/00	140 x 108 x 90
63A	80A	CS 173246U080	W076310	FU3760/63A/00	150 x 114 x 107

Table 5-2 Recommended high-speed fuses for SSC protection
Three-phase fuseholders with three fuses.

Maximum operating voltage for fuses: 500Vac (line-to-line).

Protection for fan connection (63A rated unit)

A protection fuse for the fan connection (63A nominal current) must be installed in each conductor connected to a supply phase.

Line-to-line voltage (max.)	0.5A fuse 6.3 x 32mm Reference		Fuse-holder isolator Reference	'Fuse-isolator' assembly dimensions (mm)
	Model Code	Ferraz	Eurotherm	
250V	CS174290U0A5	J084303	CP174293	63 x 15 x 52

Table 5-3 Recommended protection fuse for fan connection

The same fuse must be installed to protect the control circuit connection if used with 24 to 48Vac and 100 to 230Vac inputs.

SERVICING

SSCs must be mounted with the heatsink positioned vertically, with no obstructions above or below which could inhibit or impede airflow.

Warning !

If several units are mounted in the same cabinet, they should be arranged in such a way that air expelled from one cannot be drawn into the unit located above it.

In order to ensure correct cooling of the unit, users are advised, depending on the degree of environmental pollution, to regularly clean the heatsink and (for 63A rated units) the protective fan guard.

Danger !

Cleaning should only be carried out with the supply disconnected and at least 15 minutes after it has ceased operating.

Every six months check that the screws of the power and safety ground cables are correctly tightened (see ‘Wiring’ page 3-3).

TOOLS

Task	Flat-blade screwdriver (mm)	Hex key
Safety ground wiring Power wiring	0.5 x 4	HEX 8 (M5)
Fan (63A rated unit) and control wiring	0.5 x 2.5	

Table 5-4 Tools